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# Higher order methods for simulating fracturing with applications in multiphysics problems

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## ABSTRACT

We develop higher order finite element methods for fracture mechanics. The framework is cast within the context of conforming finite elements [1]. The method [2] exploits the a priori knowledge of the singular behavior of the fields to construct an alternate regular solution. Solving for the alternate problem yields optimal rates of convergence and high order of accuracy. The salient feature of the method is the lack of additional degrees of freedom in comparison with its standard Galerking finite element formulation. Effectively for the same computational cost we obtain a higher order of accuracy. Along with the above we employ interaction integrals for curvilinear fractures as presented in [3] and generalize their definition for the proposed higher order method. Along with the optimality of the convergence of the solution we showcase the accuracy and the convergent behavior of the computed stress intensity factors. The method is verified with respect several analytical solutions. The applications of the framework are showcased for complex fracturing problems. In particular, simulations of fracture instabilities in thermo elastic materials subjected to large temperature gradients, where oscillatory fracture behavior is expected, will be used to demonstrate the robustness and capabilities of the presented tools.

## REFERENCES

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